

KENYAABSTRACT

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Five investigators report on the applicability of ERTS-I data covering the major landforms of Kenya. Deficiencies due to lack of equipment, repetitive coverage and interpretation know-how are also reported on. Revision of lake shorelines is an immediate benefit; Basement system metasediments are rapidly differentiated, but dune areas are not readily distinguishable from sandy soils. Forest, moorland, high altitude grass, tea and conifer plantations are readily distinguished, with podocarpus forest especially distinguishable from podocarpus/juniperus forest. In the arid areas physiographic features, indicating the major soil types, are readily identified and mapped. Preliminary vegetation type analysis in the Mara Game Reserve indicates that in a typical savannah area about 36% of the vegetation types are distinguishable at a scale of 1:1 m. as well as drainage patterns and terrain features.

* * * *

A. INTRODUCTION.

Due to lack of personnel and facilities the Principal Investigator has been unable, to date, to conduct the planned investigation and analysis of data received from ERTS-I; as a result he acted largely as a centre for storing, cataloguing and informing the various agencies dealing with natural resource management in the country, on the availability and coverage of ERTS-I imagery.

However very encouraging responses were received from the Zoology, Botany and Meteorology Departments of the University of Nairobi, the Mines and Geological Department, the Water Development Department, the Game Department and the FAO/Wildlife Management Project, as a result of imagery being available to them for study.

Most of the investigations being carried out are still in the preliminary stages of development due to lack of adequate facilities and techniques required for studying and applying ERTS-I imager. It is hoped that the

cont./2

(E74-10134) [THE APPLICABILITY OF ERTS-1
DATA COVERING THE MAJOR LANDFORMS OF
KENYA] Final Report (Ministry of
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Unclas

forthcoming Seminar/Workshop on Remote Sensing to be held in Nairobi in March-April 1974 will provide local personnel with an adequate background to enable them to utilise ERTS imagery.

B. REPORTS

The following interim reports have been submitted by investigators:

- (1) Dr. J. Walsh
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Ministry of Natural Resources
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NAIROBI, KENYA

IMAGERY OF 10TH SEPTEMBER 1972

E - 1049 - 07213 - 7 (299) BLACK & WHITE 1:1,000,000.

E - 1049 - 07215 - 7 (300) BLACK & WHITE 1:1,000,000

S.E. LAKE RUDOLF, KENYA

Fairly detailed study of this imagery, without immediate access to other black and white versions of the same area have shown the following:

(a) The shoreline of L. Rudolf is reproduced with extreme clarity, even in extremely shallow water, as in Ferguson's Gulf (common to both images). The build-up of the various arms of the Omo delta, in the extreme north is particularly striking and shows very marked changes from air photography of fifteen years ago. A sedimentological study of the same delta would be greatly facilitated by the light and dark grey patterns in the lake, though whether these are a feature of the lake bottom or of muddy water can only be decided by comparison with imagery of other dates.

(b) Tonal and textural differences easily differentiate Basement system metasediments (e.g. at 04° 30' N, 36° 00'E at 02° 45' N 35° 10'E., and at 02° N., 35° 20'E) and volcanics - the dark grey areas elsewhere. The images do not clearly distinguish between plain sandy soils, as in the centre of -1049 - 07215 - 7, and areas of strong development of dunes, as at 03° 00' N., 36° 15' E. Neither is a very marked raised beach, running south from the spit at Ferguson's Gulf, readily distinguishable.

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IMAGERY OF 9TH SEPTEMBER 1972

E - 1048 - 07170 - 7 BLACK & WHITE, 1:1,000,000

CENTRAL RIFT VALLEY, KENYA

Again only a single image, black and white spectral band 7 was studied in detail. As in the case of L. Rudolf, the shorelines of the several lakes are remarkably clear, though in this case no lake-bottom detail is apparent, even in lakes Nakuru and Elementaita ($00^{\circ}20'S.$; $36^{\circ}25'E$) which are only a few feet deep.

The main eastern wall of the rift, running from NNW to SSE approximately through the centre of the photo, is very well shown. The western wall some three inches to the left, is much less well marked (on the ground as well) and the dissected scarp cut in soft tuffs and ashes can only be picked out if the observers know where to look. Menengai Caldera, north of Lake Nakuru and almost centre to the image is well shown, but not immediately recognisable as a caldera.

The mottled (lava) country in the north-east quadrant is something of a puzzle. The geology there is mostly flat-lying Miocene plateau phenolites, with a fairly good grass cover. I would imagine the mottling to be a result of different soils - but this needs to be checked in the field. The Uaso Nyiro swamp is remarkably clear at $00^{\circ}30'N.$, $36^{\circ}40'E$. As in the Rudolf photographs, Basement system metasediments (extreme NE corner) are unmistakable.

There are several areas here that are notably hot with steam-jets and geysers, namely Lake Hannington (centre) and near Lake Naivasha (extreme south). None are immediately obvious in this picture, but comparison with other imagery might show such hot areas.

(2) Dr. E.E. Zamierowski
Department of Botany
University of Nairobi
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The main effort has been directed towards a general familiarity with ERTS data and literature and the feasibility of recognising vegetation types. Colour transparencies (35 mm.) have been made of the false colour composite images for teaching and demonstration purposes. Attempts were made to enlarge portions of the false colour composites to a scale of approximately 1:250,000, but the quality of local colour printing was not consistent nor satisfactory.

Since a detailed vegetation map of 1:250,000 scale (Trapnell, et al. 1966) exists of a large portion of western Kenya, an attempt was made to identify mapped vegetation types on the 1:1,000,000 black and white ERTS imagery. Bands 4 and 5 seem to show best separation of natural vegetation, while cultivated areas appear most distinctly on bands 6 and 7. Black and white images made on 1st Feb. 1973, E - 1193 - 07230 of the Mt. Elgon - Cherangani area and E - 1193-07232 of the Kakamega - Kisumu areas were studied in conjunction with false colour composites made on 28th September 1972 E-1067 - 07221 and E - 1067 - 07224, respectively.

The mountain forests on Elgon and the Cheranganis were very distinctive on MSS Band 5 as the darkest tones. Riverine forests also showed up distinctly. The grasslands on the Cheranganis could easily be distinguished from the forest and was a lighter tone than the moorlands of Mt. Elgon. The main blocks of forest at Kakamega, Nandi Hills, and the western Mau were easily recognised, especially on bands 4 and 5. Conifer plantations could be seen within the forests and appeared most distinct on band 4. The tea plantations around Kericho could be distinguished from the conifer plantations, as they were slightly darker than the conifers but lighter in tone than the indigenous forest.

When the 1:250,000 photoprint enlargements of the false colour composites of the Mt. Elgon and Kisumu areas arrived from NASA (E - 1067 - 07224 and E - 1067 - 07221 respectively) several more vegetation types could be recognised. A tracing of the vegetation map was placed over the enlarged colour composite and it was noticed that the enlargement was slightly smaller than the map tracing at 1:250,000 scale.

From the colour composites the following vegetation classes could be distinguished

- a. grassland
- b. bamboo thicket
- c. podocarpus forest
- d. podocarpus - cedar forest
- e. cultivation clearings
- f. intensive cultivation
- g. acacia woodland (this was less easy to relate to the map than the more dense forest and grassland types)
- h. combretum savannah
- i. burned fields
- j. conifer plantations
- k. tea plantations

The area of podocarpus forest recognised on the eastern side of the Cheranganis was seen to be much reduced from that shown on the map, indicating the potential for up-dating information from older mapping. Where the vegetation becomes sparse, as in the arid parts of the Rift Valley, it is difficult to distinguish types shown on the map-probably due to the greater reflectivity of the ground surface in comparison to the vegetation. Broad-leaved savannah types were also difficult to recognise on the enlargements.

Black and white transparencies (9.5" x 9.5") were examined with an overhead projector, but did not project very well and trying to overlay two or more bands or introduce a red filter over the transparency made the image so dark as to be useless. Colour transparencies (9.5" x 9.5") on the other hand projected well with the overhead projector. Examining two spectral bands, e.g. 4 and 5 with a stereoscope gave promising results as an aid in discrimination of types. Better stereo results were obtained from overlapping areas of adjacent pairs, notwithstanding that the overlap was only about 5% and only for peripheral areas of the imagery

(3) Dr. W.G. Sombroek
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National Agricultural Laboratories
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NAIROBI, KENYA

The project has started to use the ERTS-I imagery as a tool for the mapping of soil resources at exploratory level. On scales at 1:500,000 - 1:1,000,000 for the country as a whole. Particularly for the arid and semi arid parts of the country (2/3 of the total surface of Kenya) the imagery is proving to be of invaluable help. Due to their limited or non-existing rain fed production potential, these areas have been studied very little in the field, with ordinary techniques of soil survey. Broad soil mapping in these areas is however much wanted, not only for pure scientific purposes but also because of plans for both irrigation development and range management development. In these areas, covered for a good part with unconsolidated quaternary sediments, the soils show in general a very clear - cut relationship with broad physiographic units, like sheetwash plains, river terraces, floodplains etc. Therefore relatively few field observations and sampling are sufficient for mapping if the mentioned physiographic units can be accurately delineated. This can be partly done from existing geological maps and aerial photographs, but the ERTS- imagery is not only a much quicker and cheaper tool; but is also more reliable and refined. This is because each physiography - soil unit has its own pattern of soil infiltration rate, drainage condition, soil moisture storage capacity, effective rooting depth and salinity - alkalinity often a reflection of quaternary climatic change. Moisture always being in the minimum, these . . . differences reflect clearly in the composition of the vegetative cover (trees, shrubs grasses) as well as the degree and pattern of green foliage at a given time after the start or end of the rains. These differences in green foliage are reflected very strikingly on the false - colour ERTS images. At the same time the over-all occurrence of green matter

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is so restricted, that differences in the appearance of the bare soil surface shows up equally well.

The images are also an excellent tool for teaching and training in physiographic aspects of soil survey and land evaluation in general.

(4) Dr. Charles Pase
Habitat Ecologist
FAO/Kenya Wildlife Management Project
P.O. Box 30559
NAIROBI, KENYA

Our major interest in the ERTS-I imagery for Kajiado District, Central Province, Kenya lies in mapping areas of extensive drought, and areas of varying plant growth stages. "Phenology" or growth stage of range vegetation appears to be highly correlated with distribution of certain free-range game animals, notably wilde beeste and zebra.

Sequences of false-colour ERTS-I imagery will be compared with animal distribution data from our District wide reconnaissance flights which are planned for 3-4 times per year during the life Wildlife Management Project. We feel that ERTS imagery will significantly aid in interpreting the game animal distribution data obtained by these large-scale census flights.

Unfortunately the area in question was only scanned once and that too under heavy cloud cover. Repetitive coverage would have been extremely beneficial.

(5) Mr. Simon Taiti
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Head, Research Division
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INTERPRETABILITY OF ERTS-I FALSE COLOUR IMAGERY FOR DETAILED
VEGETATION MAPPING WITH REFERENCE TO THE SOUTH WESTERN (MARA)
AREA OF KENYA (E - 1048 - 07172 - 9TH SEPT. 1972) 1:1,000,000

Having mapped the vegetation of the Masai Mara Game Reserve in the Narok District by physiognomic criteria determined on the ground in 1971-72, and using aerial photographs to determine changes in the vegetation, I have attempted to analyse visually and interpret the ERTS-I false colour imagery in a test of consistency of registration of the known data.

To key and decode the signatures of the false colour images I am using a 'Robbialac Paints Colour Card'. I am using one frame in blue, one in pink and one in orange. The scene includes Narok District (entire), Mau Forest (southern half), Lake Naivasha, southern end of Aberdares ranges, Suswa, Nguruman Escarpment, Magadi and Ngong - Nairobi areas.

The Masai Mara Game Reserve is roughly 600 square miles and within this scene, with prior knowledge of what to look for, I am able to depict about 35% of the type-units of vegetation, and the terrain fairly well.

The Table (I) below shows the codes for signatures and success of registration at the scale of one frame (approx. 7.5" x 7.5" for 13,000 miles)

SUCCESS OF DISCERNING PHYSIOGNOMIC VEGETATION TYPES OF ERTS-I IMAGERY

TYPE	SIGNATURE (ROBBIALAC) CODE	SUCCESS OF REGISTRATION	
		DISCERNIBLE:	UNDESCERNIBLE
1. Mid-altitude Riparian <u>Warburgia-Diospyros</u> Forest	poppy	1	0
2. <u>Croton di chogamus</u> riverine and hill top bushland	cappuchino	1	0

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TYPE	SIGNATURE (ROBBIALAC) CODE	SUCCESS OF REGISTRATION	
		DISCERNIBLE:	UNDESCERNIBLE
3. <u>Themeda</u> grassland	silk grey	1	0
4. <u>Setaria</u> - <u>Themeda</u> grassland	whisper grey	1	0
5. <u>Lannea</u> - <u>commiphora</u> - <u>Dischrostachys</u> woodland	?	0	1
6. <u>Acacia hockii</u> woodland	?	0	1
7. <u>Acacia drepanolobium</u> woodland	?	0	1
8. <u>Acacia gerrardii</u> wood- land	?	0	1
9. <u>Acacia xanthophloea</u> woodland forest	coralline	Inconsiderable	
10. <u>Balanites aegyptiaca</u> woodland	sunburst	0	1
11. <u>Euclea divinorum</u> vegetation	?	0	1
12. <u>Rhus - cordia</u> termite mound thickets	?	0	1
TOTAL		4	7
SUCCESS		36%	64%

Within the Masai Mara Game Reserve, registration is also good in

(a) Drainage pattern; (the Mara Talek, Sand River, Jagar tiek, and Okeju Robkai rivers are all discernible)

(b) Terrain, as interpreted in association with signatures of vegetation characteristic to each type of topography.

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At the present scale of 1:1,000,000 approximately 35% of detailed data is discernible. An enlargement of x3 to x5 may bring about 90% success.

(C) SUMMARY

Although a great deal of enthusiasm has been shown in receiving ERTS-I imagery by investigators a lot of potential investigators in the field of vegetation studies were unable to carry out any research due to lack of coverage in some interesting areas and absence of repetitive coverage in others.

KS/Dralika

27/46/01

Ministry of Natural Resources
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GSFC Technical Contact
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7th December, 1973.

Dear Sir,

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semination of Earth Resources Survey
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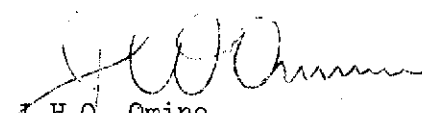
ERTS-I FINAL REPORT

Enclosed please find two copies of the Kenya Final Report for the investigation SR 9658.

In view of the lateness of submission I am copying this letter direct to all those bodies requiring copies, together with the report.

At this juncture I would like to express the Kenya Government's sincere application of the valuable cooperation which all those involved in the ERTS programme have rendered to us in the supply of data, information, enlargements and, more recently, the prospect of a cooperative Seminar/Workshop on Remote Sensing, a Cost/Benefit study currently on-going and the tentative Population Census Project based on ERTS data. These are potentially of great benefit to our programmes of national development.

Yours sincerely,


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